Memorandum

Foth Infrastructure & Environment, LLC

2121 Innovation Court, Suite 300
P.O. Box 5126 • De Pere, WI 54115-5126
(920) 497-2500 • Fax: (920) 497-8516
www.foth.com

June 2, 2017

TO: Master File – 17A021

CC: Kris Baran, Foth Infrastructure & Environment, LLC
Steve Donohue, Foth Infrastructure & Environment, LLC

FR: Dave Donohue, P.E., Foth Infrastructure & Environment, LLC

RE: 100-Year Floodplain Delineation - Revise

Purpose

The purpose of this memorandum (memo) is to satisfy requirements of the Michigan Department of Environmental Quality (MDEQ) Nonferrous Metallic Mining Regulations, Part 301 Inland Lakes and Streams permitting requirements and Part 31 Floodplain permit regulations by defining the floodplain and the impacts the associated flooding would have on the mine operation, if any.

Background

MDEQ Nonferrous Metallic Mining Regulations, Part 632, Part 1, R 425.102, Rule 102 defines "floodplain" as: "(o) 'Floodplain' means an area of land adjoining a river or stream that will be inundated by a flood with a magnitude that has a 1% chance of occurring or being exceeded in any given year."

Rule 202 requires description and definition of the floodplain and the area affected by the floodplain as well as a description of the impacts, if any, that the proposed mining activity will have on the floodplain.

Analysis

As directed in comments received from the MDEQ Floodplain Engineer (Linda Hansen) for the Upper Peninsula District in a letter dated April 3, 2017 (MDEQ, 2017), the floodplain delineation contained herein is based on a 1992 floodplain delineation study prepared by the United States Army Corps of Engineers (USACE, 1992).

The USACE (1992) study projected water surface elevations for the Menominee River corresponding to the 100-year discharge at select locations along the river in Menominee County. The two locations closest to the Project at which the 100-year stage was estimated include an upstream location that is immediately downstream of the White Rapids Dam, and

a downstream location that is upstream of the confluence of the Shakey River and the Menominee River and approximately 32,225 feet downstream from the White Rapids Dam. USACE (1992) estimated the 100-year flood stage downstream of the White Rapids Dam as 703 feet above mean sea level (amsl). USACE (1992) estimated the 100-year stage at the location near the Shakey River-Menominee River confluence as 687 feet amsl. Flood stages reported in USACE (1992) are based on the National Geodetic Vertical Datum of 1929 (NGVD29).

As requested in MDEQ (2017), the floodplain in the Project area was defined by interpolating between the upstream and downstream stage-projection locations from USACE (1992) at 0.1-foot stage intervals and projecting these estimated flood stages to their intercept with the ground surface on the Michigan side of the Menominee River. Ground surface topography in the Project area is defined from a 2010 LiDAR survey of the Project area and has an estimated accuracy of 0.5 feet or better. The LiDAR topographic survey of the Project area is based on the North American Vertical Datum of 1988 (NAVD88).

Flood stage elevations from USACE (1992) at the upstream and downstream locations were converted from the National Geodetic Vertical Datum of 1929 (NGVD29) datum to the NAVD88 datum using the conversion tool at https://www.ngs.noaa.gov/cgi-bin/VERTCON/vert_con.prl. The flood stage elevation of 703 feet amsl (NGVD29) at the White Rapids dam is 702.93 feet amsl (NAVD88) after conversion. The flood stage elevation of 687 feet amsl (NGVD29) near the Shakey River-Menominee River confluence is 686.92 feet amsl (NAVD88) after conversion. The estimated stage for the 100-year flood in the vicinity of the Project ranges from approximately 694.7 feet amsl (NAVD88) southwest of pit to 695.9 feet amsl (NAVD88) northwest of the pit.

Figure 1 shows the floodplain boundary in the Project area obtained from interpolating the USACE (1992) flood stage projections near the White Rapids Dam and the mouth of the Shakey River. Figure 1 includes contours depicting the ground surface elevation based on the Project LiDAR survey. Also shown on the figure are Project features as requested by MDEQ (2017), including the pit perimeter, River Road, Project boundary fence, and cut-off wall. As shown on Figure 1, no project improvements are proposed within the 100-year floodplain.

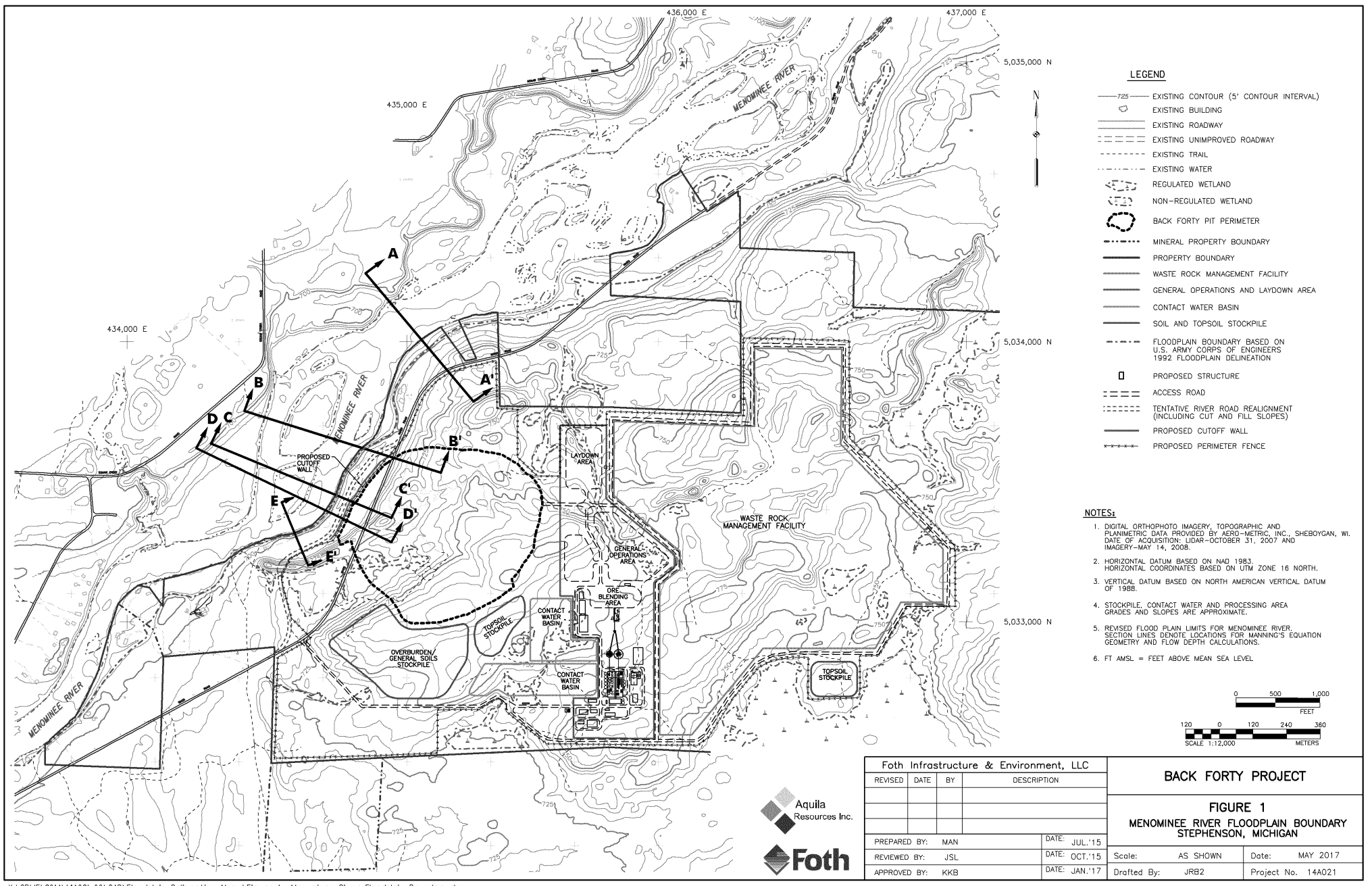
Figures 2 through 6 show the extent of the 100-year floodplain relative to proposed Project improvements in cross-sectional view. As illustrated in the plan-view of the floodplain limit on Figure 1, the cross-section views indicate that all proposed Project improvements are located outside the floodplain limit and above the projected 100-year flood stage elevation.

References

Michigan Department of Environmental Quality (MDEQ), 2017. *Addendum to Correction Request – Part 31 Floodplains Review.* Linda D. Hansen, UP District Floodplain Engineer, Braga/Houghton Field Office, Water Resource Division, Michigan Department of Environmental Quality. April 3, 2017.

United States Army Corps of Engineers (USACE), 1992. *Special Study, Menominee River, Menominee County, Michigan.* United States Army Engineer District, Detroit, Michigan. September 1992.

Figures



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REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	MAN	DATE:	JUL.'15
REVIEWED BY:	JSL	DATE:	OCT.'15
APPROVED BY:	KKB	DATE:	JAN.'17

BACK FORTY PROJECT

FIGURE 1
MENOMINEE RIVER FLOODPLAIN BOUNDARY STEPHENSON, MICHIGAN

Scale:	AS SHOWN	Date:	MAY 2017
Drafted By:	JRB2	Project No.	14A021

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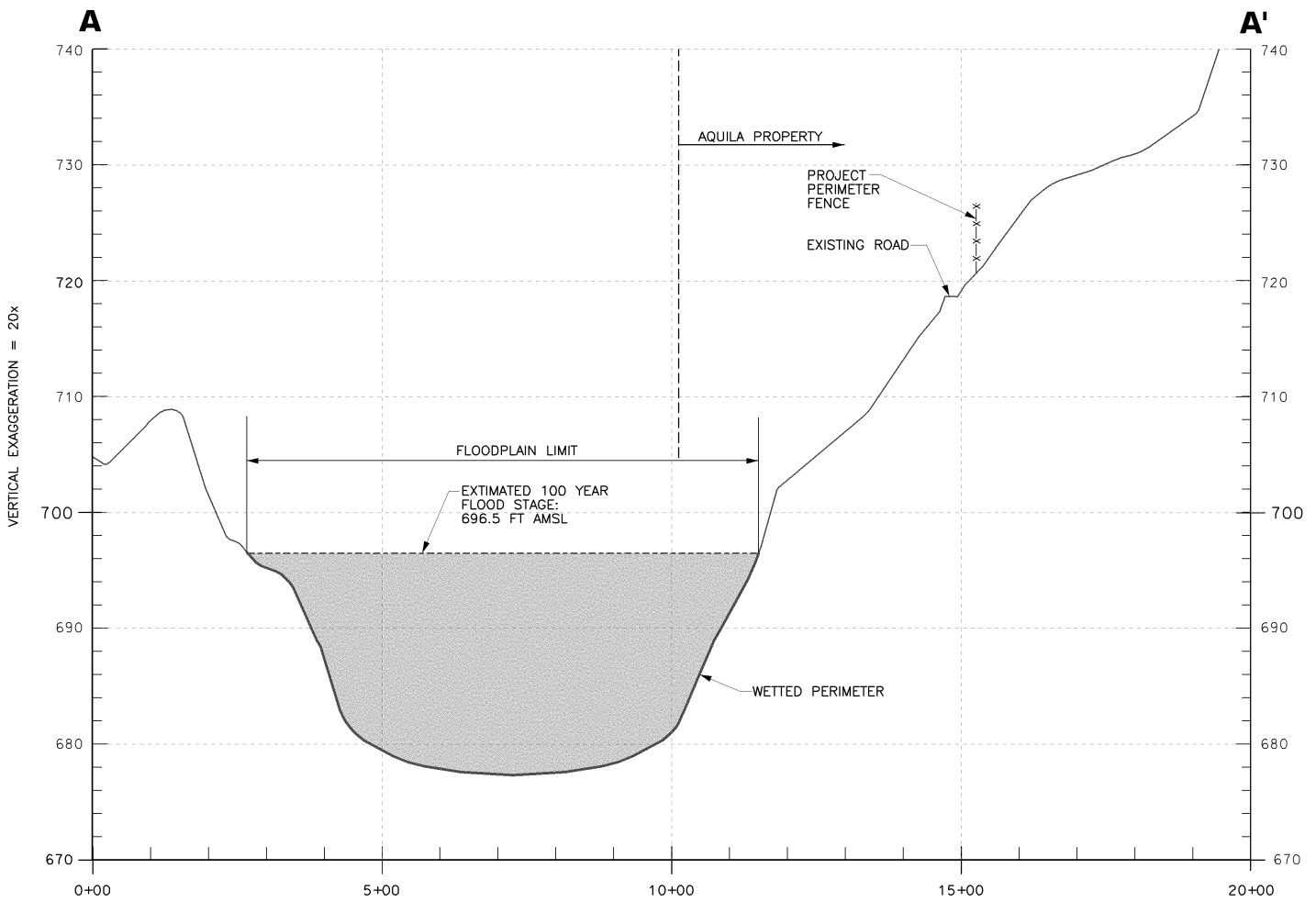
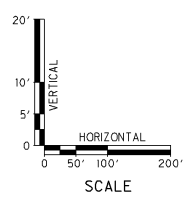
5/12/2017 JRB2



NOTES:

1. HORIZONTAL DATUM BASED ON NAD 1983. HORIZONTAL COORDINATES BASED ON UTM ZONE 16 NORTH.
2. VERTICAL DATUM BASED ON NORTH AMERICAN VERTICAL DATUM OF 1988.
3. REVISED FLOOD PLAIN LIMITS FOR MENOMINEE RIVER. SECTION LINES DENOTE LOCATIONS FOR MANNING'S EQUATION GEOMETRY AND FLOW DEPTH CALCULATIONS.
4. FT AMSL = FEET ABOVE MEAN SEA LEVEL



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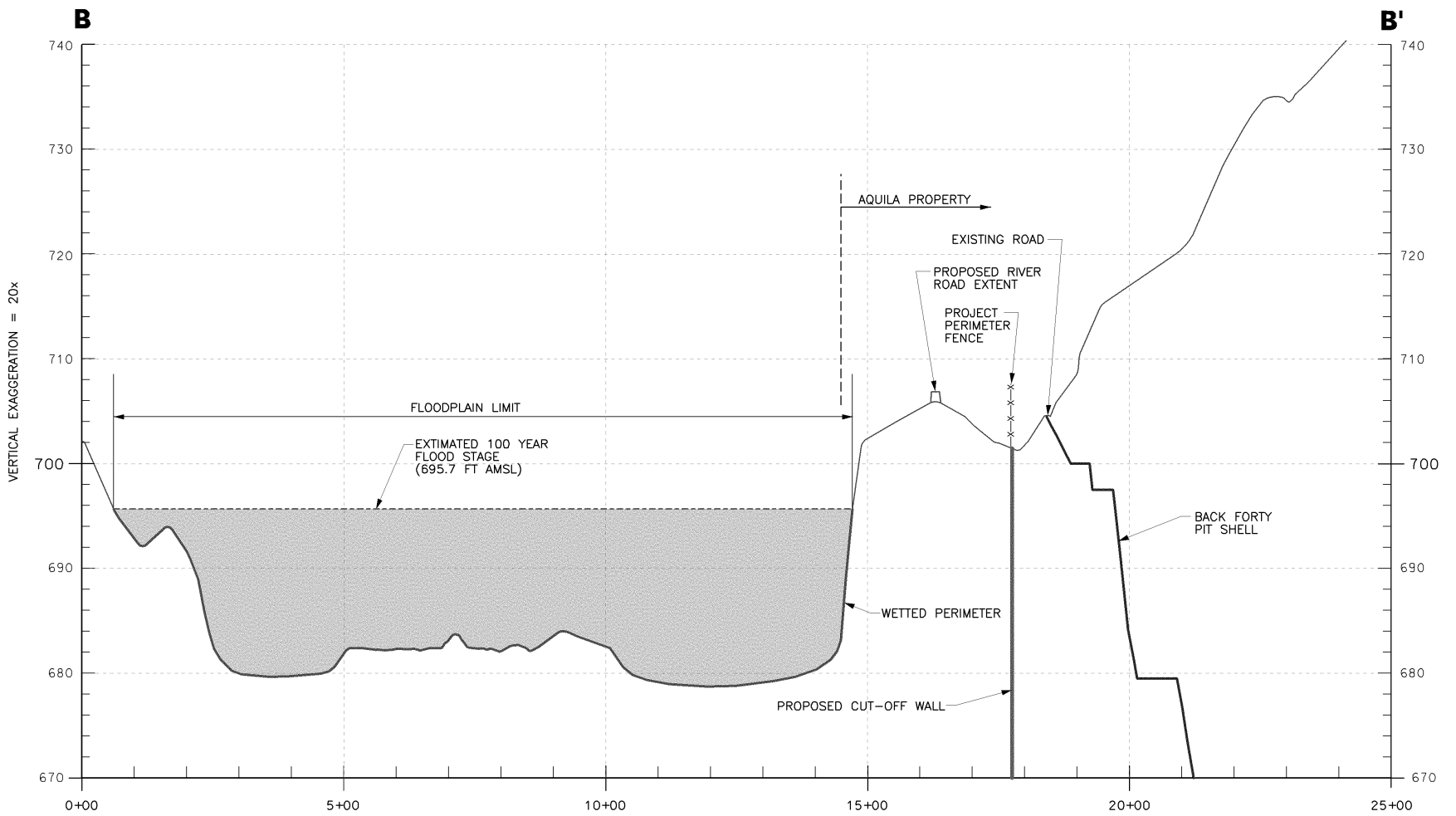
REVISED	DATE	BY	DESCRIPTION	
PREPARED BY:	DRD		DATE:	MAY '17
REVIEWED BY:			DATE:	
APPROVED BY:			DATE:	

BACK FORTY PROJECT

FIGURE 2
FLOODPLAIN STAGE AND LIMITS
CROSS SECTION A – A'
STEPHENSON, MICHIGAN

Scale:	SEE BAR SCALE	Date:	MAY 2017
Drafted By:	JRB2	Project No.	14A021

X:\GB\IE\2014\14A021-00\CAD\Floodplain Delineation Memo\Figure 2 - Cross-Section A-A.dgn
5/12/2017 JRB2



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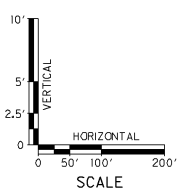

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APPROVED BY:		DATE:	

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FIGURE 3
FLOODPLAIN STAGE AND LIMITS
CROSS SECTION B – B'
STEPHENSON, MICHIGAN

Scale:	SEE BAR SCALE	Date:	MAY 2017
Drafted By:	JRB2	Project No.	14A021

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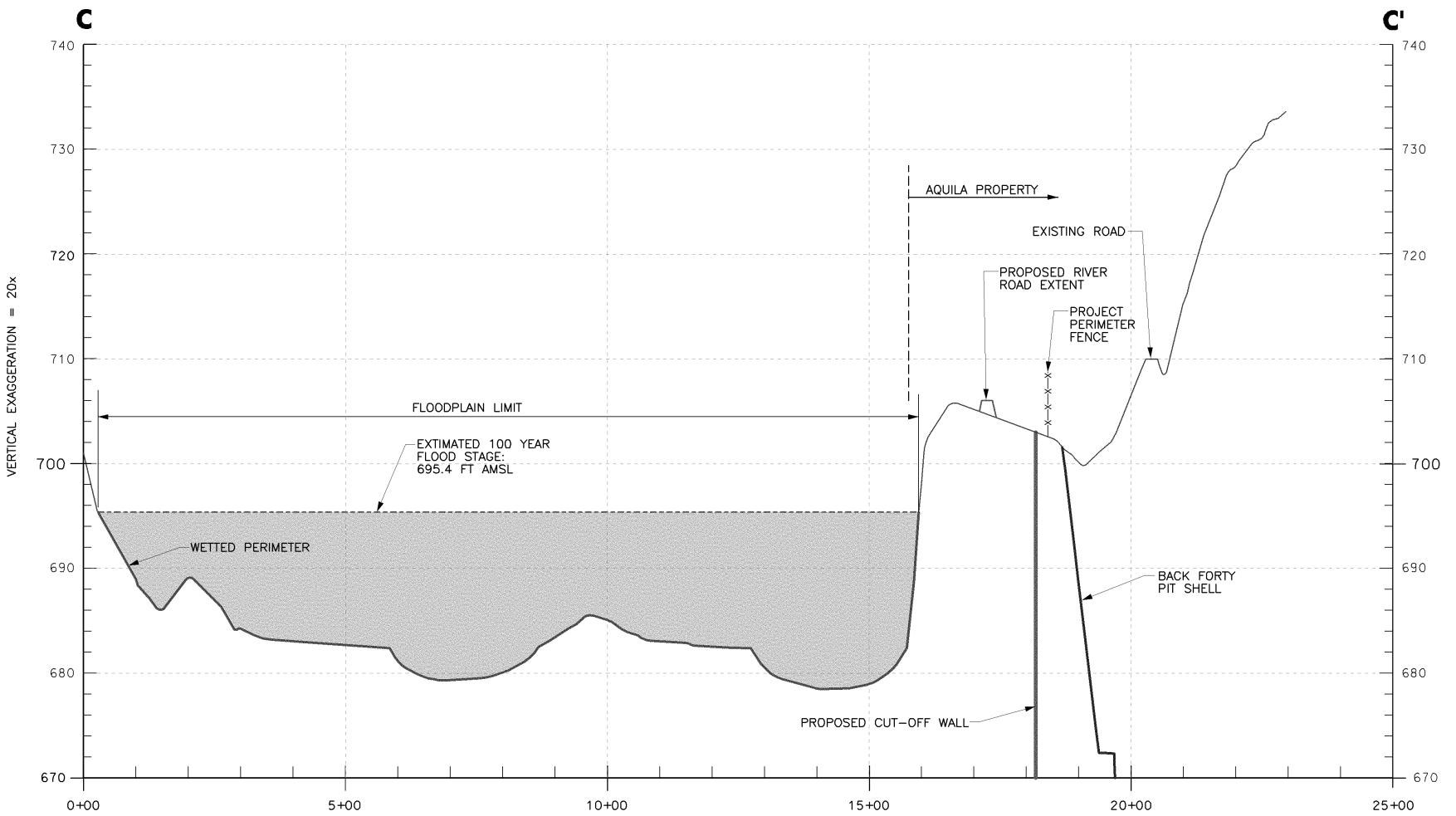

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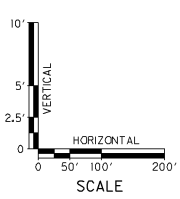

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FIGURE 4
FLOODPLAIN STAGE AND LIMITS
CROSS SECTION C – C'
STEPHENSON, MICHIGAN

Scale: SEE BAR SCALE	Date: MAY 2017
Drafted By: JRB2	Project No. 14A021

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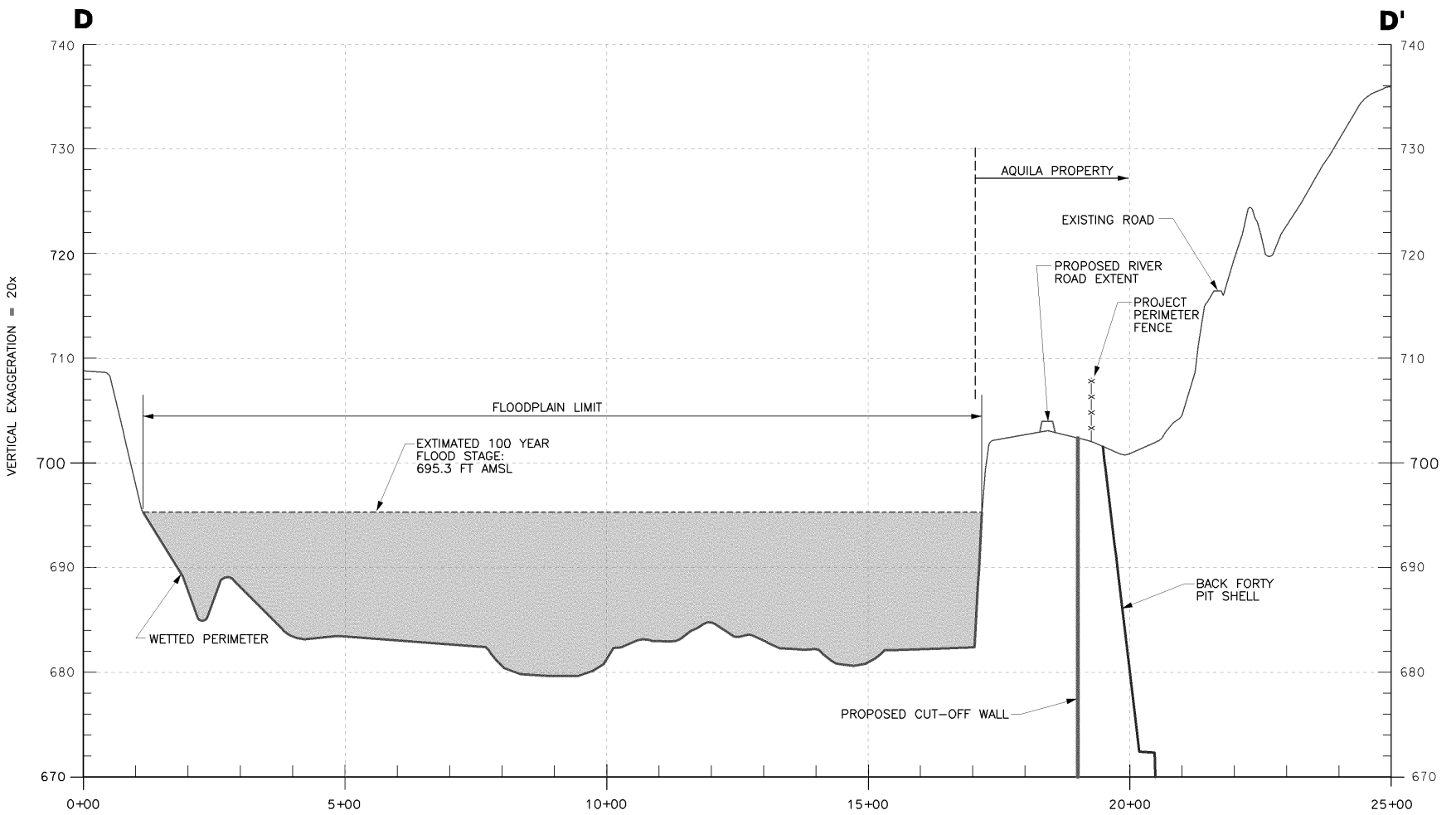

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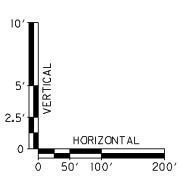

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FIGURE 5
FLOODPLAIN STAGE AND LIMITS CROSS SECTION D – D'
STEPHENSON, MICHIGAN

Scale: SEE BAR SCALE	Date: MAY 2017
Drafted By: JRB2	Project No. 14A021

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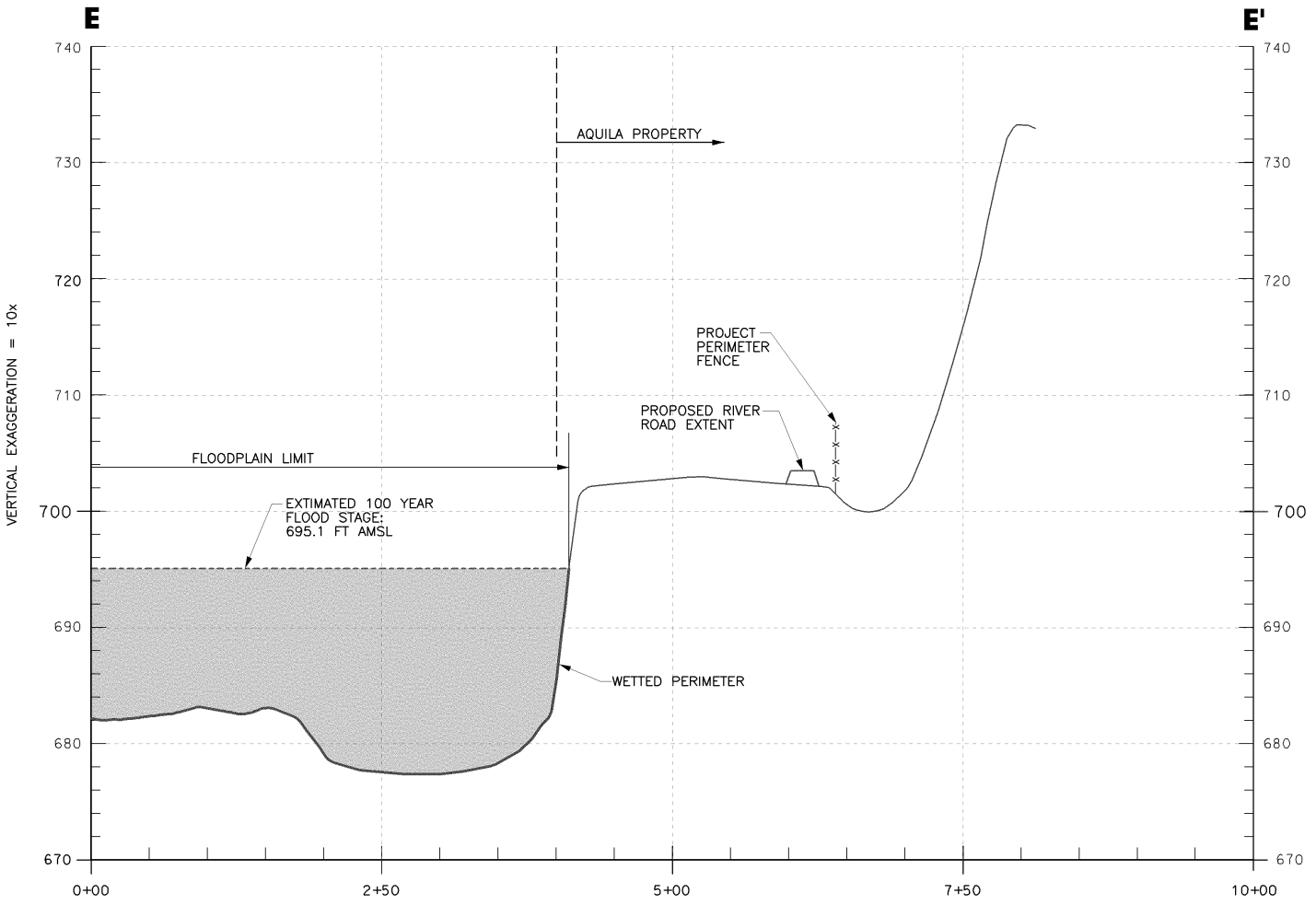

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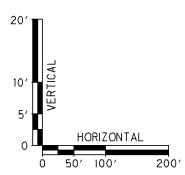

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FIGURE 6
FLOODPLAIN STAGE AND LIMITS
CROSS SECTION E – E'
STEPHENSON, MICHIGAN

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